State of Wisconsin/Department of Transportation

RESEARCH PROGRESS REPORT FOR THE QUARTER ENDING: March 31, 2007

Program: SPR-0010(36) FFY99	**Part: II Research and Development**	
Project Title: Effective Depth of Soil Compaction in Relation to Applied Compactive Energy	**Project ID:** 0092-08-11	
Administrative Contact: Tammy Khun-MArtin	**Sponsor:**	WHRP
WisDOT Technical Contact: Bob Arndorfer	**Approved Starting Date:**	10/7/07
Approved by COR/Steering Committee: $54,914	**Original End Date:**	4/7/07
Project Investigator (agency & contact): Dante Fratta and Haifang Wen – University of Wisconsin-Madison	**Current End Date:**	4/7/09
	Number of Extensions:	0

Percent Complete: 20%

Request a No Cost Time Extension (Please Select One): ☐ **YES** ☒ **NO**

Reason for No Cost Time Extension: None

Project Description:

The determination of the appropriate lift thicknesses used in embankment construction operations has important economic and engineering implications in the design and construction of roads, levees and dams. For example, small lift thicknesses may cause excessive construction costs while large lift thicknesses may reduce the compaction effectiveness and compromise the integrity of the embankment. This research proposal will use experimental results and numerical analyses to evaluate the effective depth of compaction. These results and analyses will provide the engineering understanding of the problem and justify recommendations about maximum lift thickness to be used in WisDOT embankment construction projects.

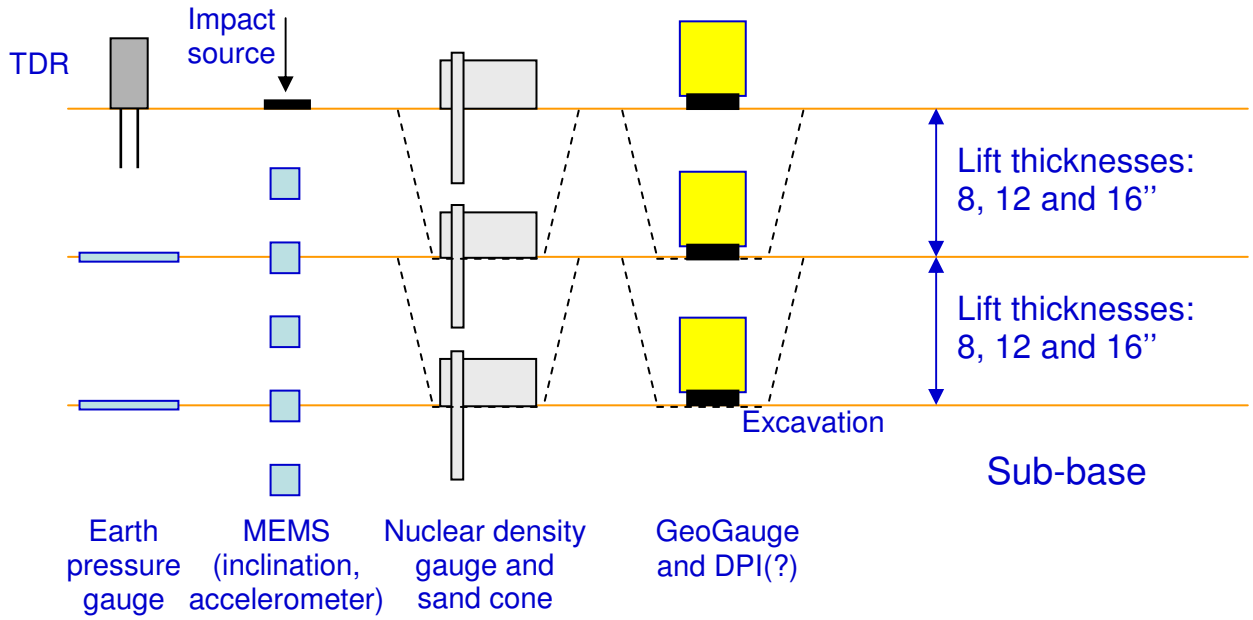
This proposed research program will collect data and develop analyses needed to determine optimum lift thickness for WisDOT embankment construction projects. The results will establish a relationship between the applied compaction energy and the level of compaction achieved at increasing depths for a number of different soils and moisture contents. The data, analyses, and correlations will help WisDOT officials in proposing possible revisions to current constructions specifications including the need to change the established 8-in lift thickness in the construction of compacted embankments. The successful completion of this research will also help WisDOT officials in improving construction operations by creating more stable and economical subgrade structures.

Progress This Quarter:

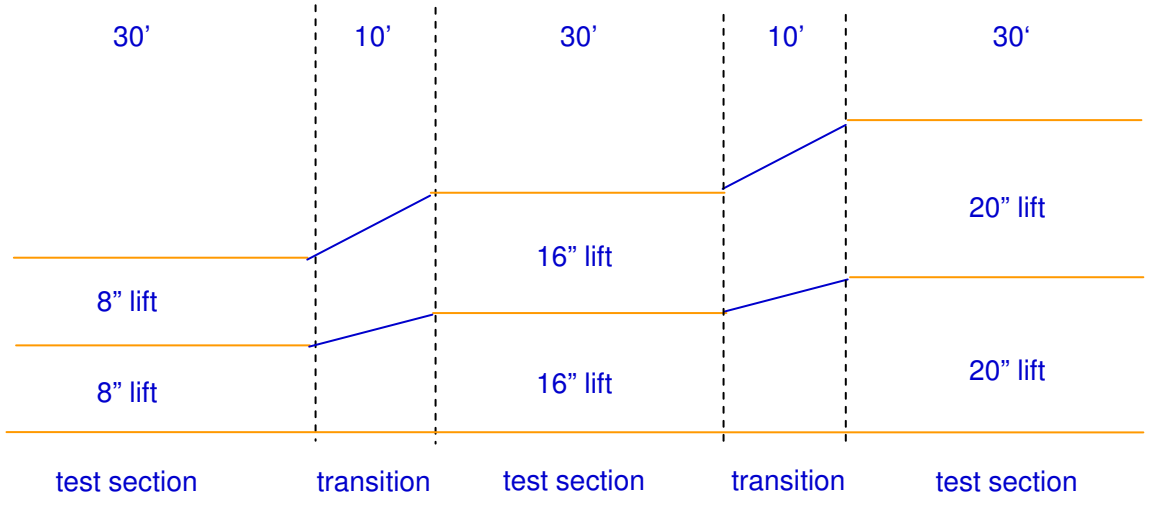
During the second quarter, the research team focused its attention to the completion of Phase I of the proposal. Phase I included a review of the state of the art compaction research, leading DOT's practices and policies, and the evaluation of modern compaction equipment specifications. The research team also started with the evaluation of theoretical/numerical and experimental

methodologies (including sensor evaluation and measurement design) for the measurement/estimation of compaction efforts (Phase II). This information will be used to perform theoretical/numerical studies to evaluate the response of different soils to compactive efforts. Finally, the research team developed a field instrumentation plan that was presented to the Geotechnics TOC members (Bob Arndorfer and Jeff Horsefall) in a Mar. 26, 2008 meeting at the DOT offices. The proposed set of measurements follows:

Field Testing Instrumentation



Field Testing Operation



Each section is 15' wide

Sub-base: made of the material as the compacted lifts

During the meeting the following list of action items/comments were developed and/or addressed:

- Mr. Bob Arndorfer will contact contractors to get a list of most frequently used compactors to compare with the proposed compaction equipment systems presented in the original proposal (i.e., sheepsfoot roller, rubber-tired roller, smooth-drum vibratory Roller). There was a concern that the proposed rubber-tired roller was instead truck tires. The research team is setting a meeting with the contractor to clarify this and other issues.
- Evaluate the effects of compaction methods on the modulus. The research team described the set of proposed measurements and the inclusion of stiffness measurements.
- Emphasis should be put on the wet side of optimum moisture content. For field tests, reduce the interval of moisture content from current 5% to 1~3%.
- The TOC requested to evaluate the effect of the size of opening on the accuracy of soil stiffness gauge and that the research should try to use DCP as added set of index measurements.
- Other issues to be addressed in the field were: change the lift thickness to 8, 12, and 16 inches, use an optical level to monitoring the compaction, minimize the effect of truck on the compaction during field tests, and put same materials under the materials to be investigated.

The Geotechnic TOC members agreed to the following testing matrix (the type of rollers needs to be re-assessed before testing):

1 - 6 passes			
Fine-grained Soil		**Coarse-grained Soil**	
Sheepsfoot Roller	**Rubber-tired Roller**	**Smooth-drum Vibratory Roller**	**Rubber-tired Roller**
Dry (1-3%<wop): 8, 12, and 16” lifts	Dry (4-5%<wop): 8, 12, and 16” lifts	Dry (4-5%<wop): 8, 12, and 16” lifts	Dry (4-5%<wop): 8, 12, and 16” lifts
Optimum: 8, 12, and 16” lifts	Optimum: 8, 12, and 16” lifts	Optimum: 8, 12, and 16” lifts	Optimum: 8, 12, and 16” lifts
Wet (1-3%>wop): 8, 12, and 16” lifts	Wet (4-5%>wop): 8, 12, and 16” lifts	Wet (4-5%>wop): 8, 12, and 16” lifts	Wet (4-5%>wop): 8, 12, and 16” lifts

Work Next Quarter:

During the second quarter the research team will complete phases II and (using the literature, data and experience obtained during the first two quarters of the project). Using the comments and action items from the meeting with Geotechnics TOC members, the research team will prepare all the instrumentation and will schedule with the contractor the beginning of the field testing. The

research team will submit to the Geotechnics TOC members an updated field testing plan for suggestions and approval. The research team will continue updating phases I, II and III.

Circumstances Affecting Progress/Budget:

None

Gantt Chart:

Phase Number	1.5 Years (18 months)					
	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 5	Quarter 6
Phase I						
Phase II						
Phase III						
Phase IV						
Phase V						